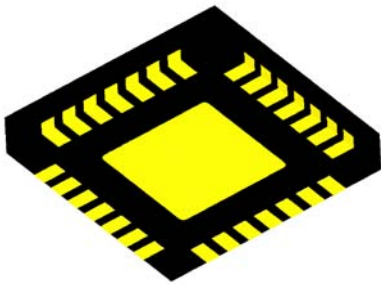




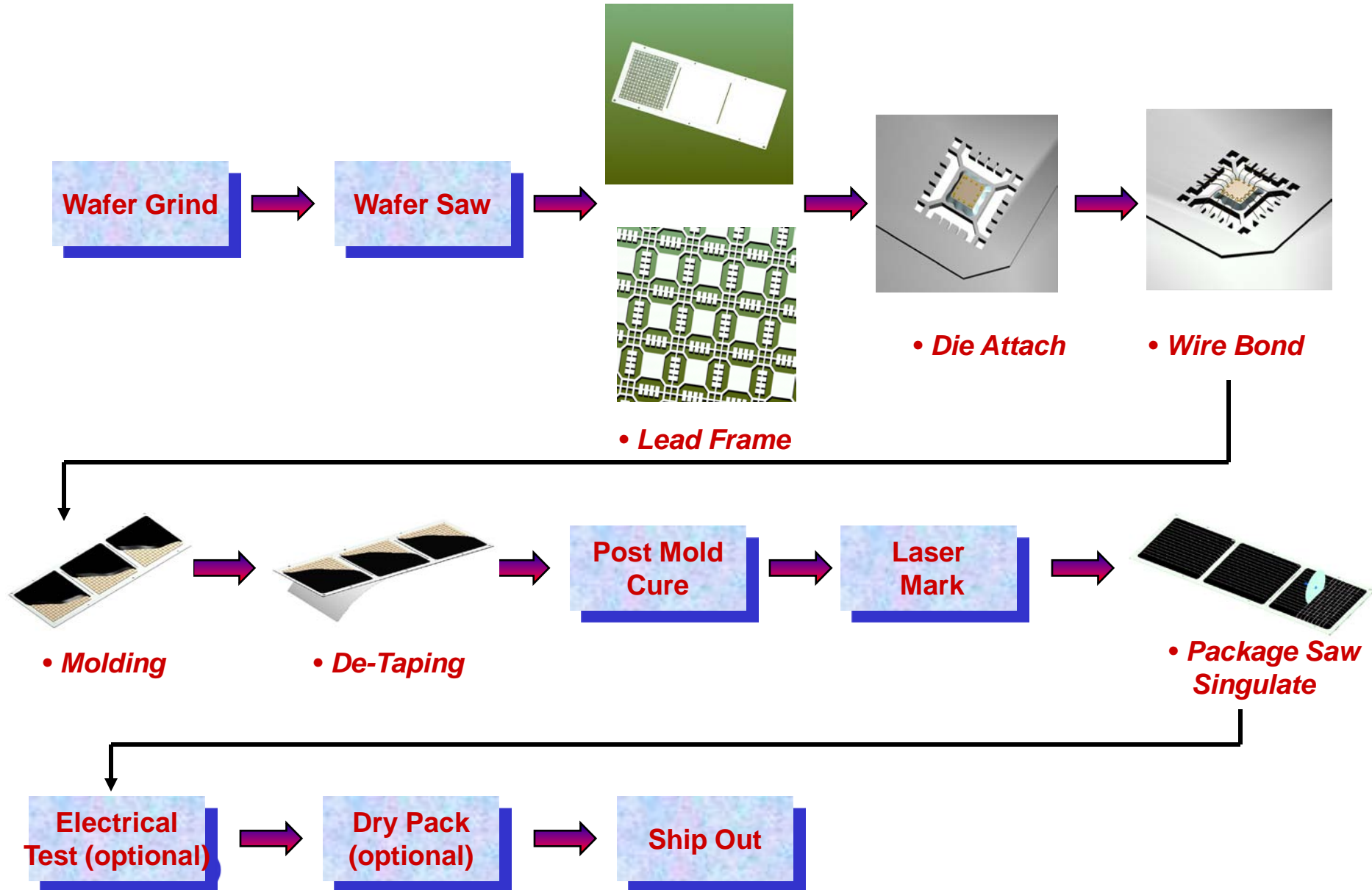
QFN Technology



I2a Technologies
Fremont
California
510 770 0322
www.i2a-tech.com

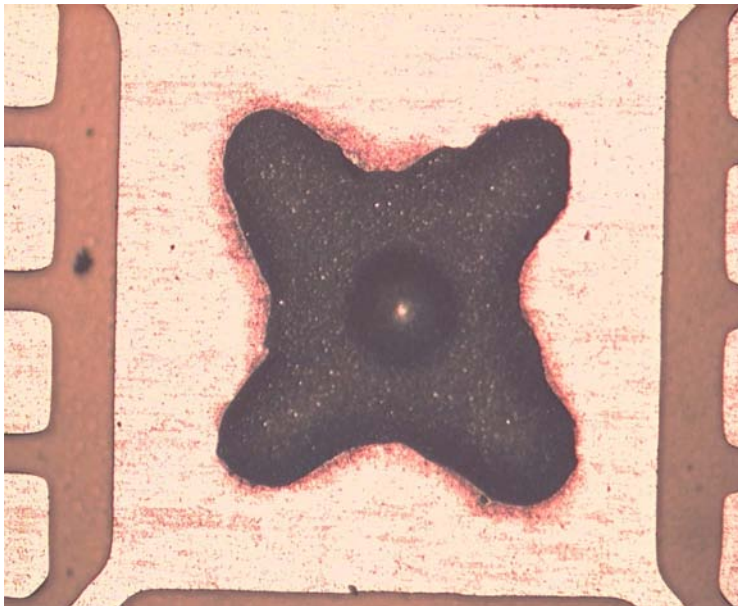
I2a Technologies

QFN Process Flow - Saw Singulate

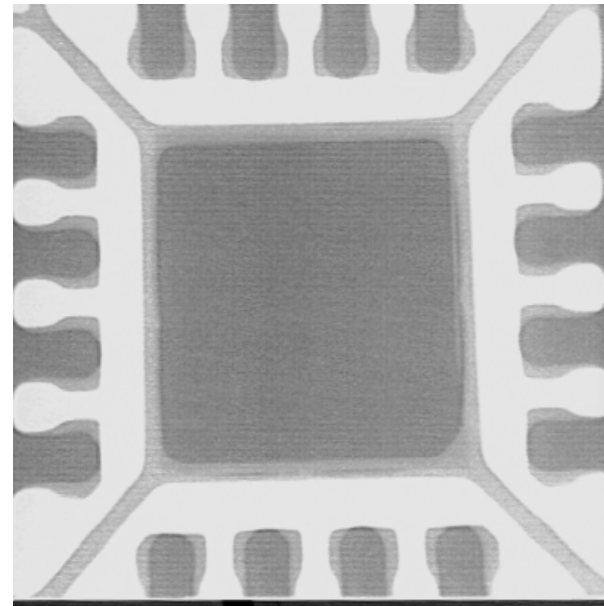


Die Attach Process

- **Die Attach Process :**
 - **Placement Accuracy :** $\leq \pm 3 \text{ mil}$
 - **Min. Die Size :** $0.2 \times 0.2 \text{ mm}$



Epoxy Pattern :



X-Ray Photos :

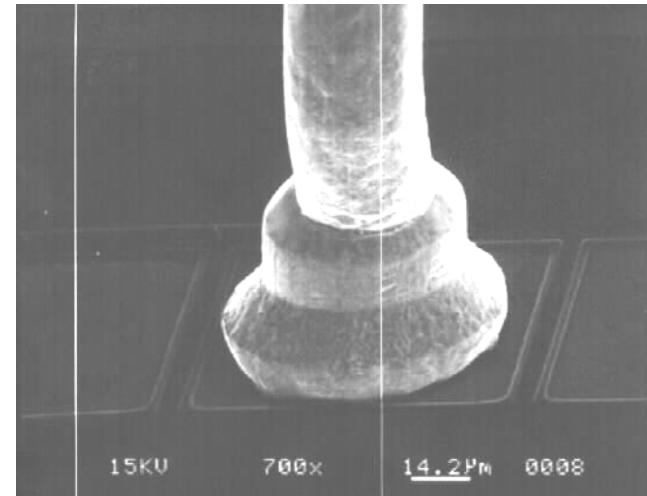
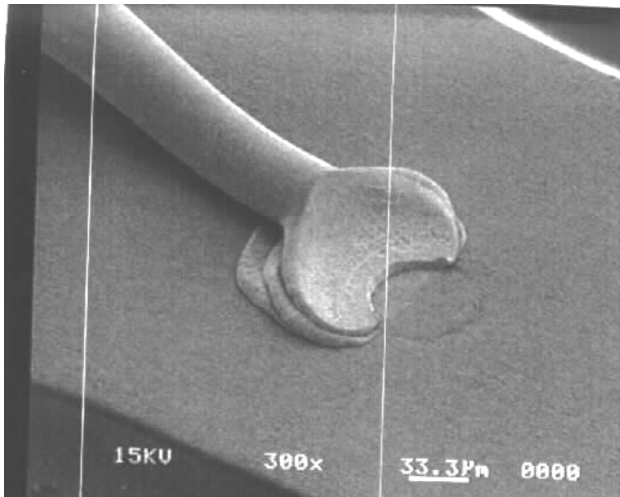
Wire Bond Process

- Wire Bonding Process :
 - Bond Pull Strength :

Wire Diameter	Pull Strength
1.0mil	3.0g
1.2mils	4.0g
1.3mils	4.0g

- Ball Shear Strength :

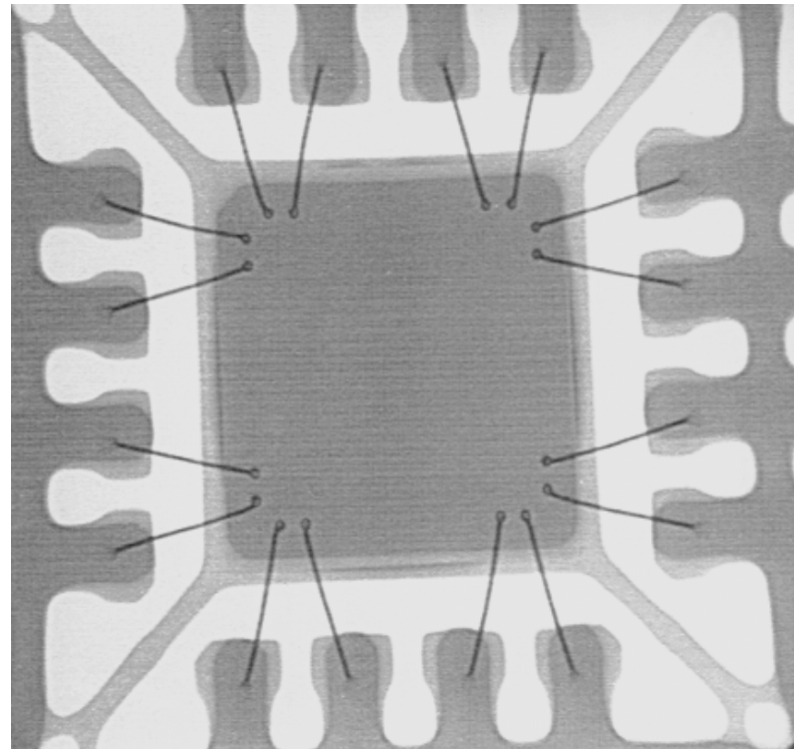
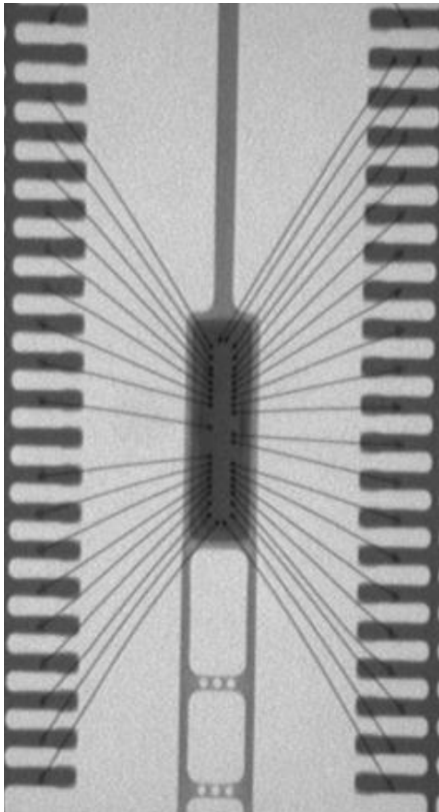
Bond Pad Opening	Ball Shear Strength
$B.P.O \leq 55\mu m$	10g
$55\mu m < B.P.O \leq 65\mu m$	15g
$65\mu m < B.P.O \leq 70\mu m$	20g
$70\mu m \leq B.P.O < 80\mu m$	22g
$80\mu m \leq B.P.O$	30g



Molding Process

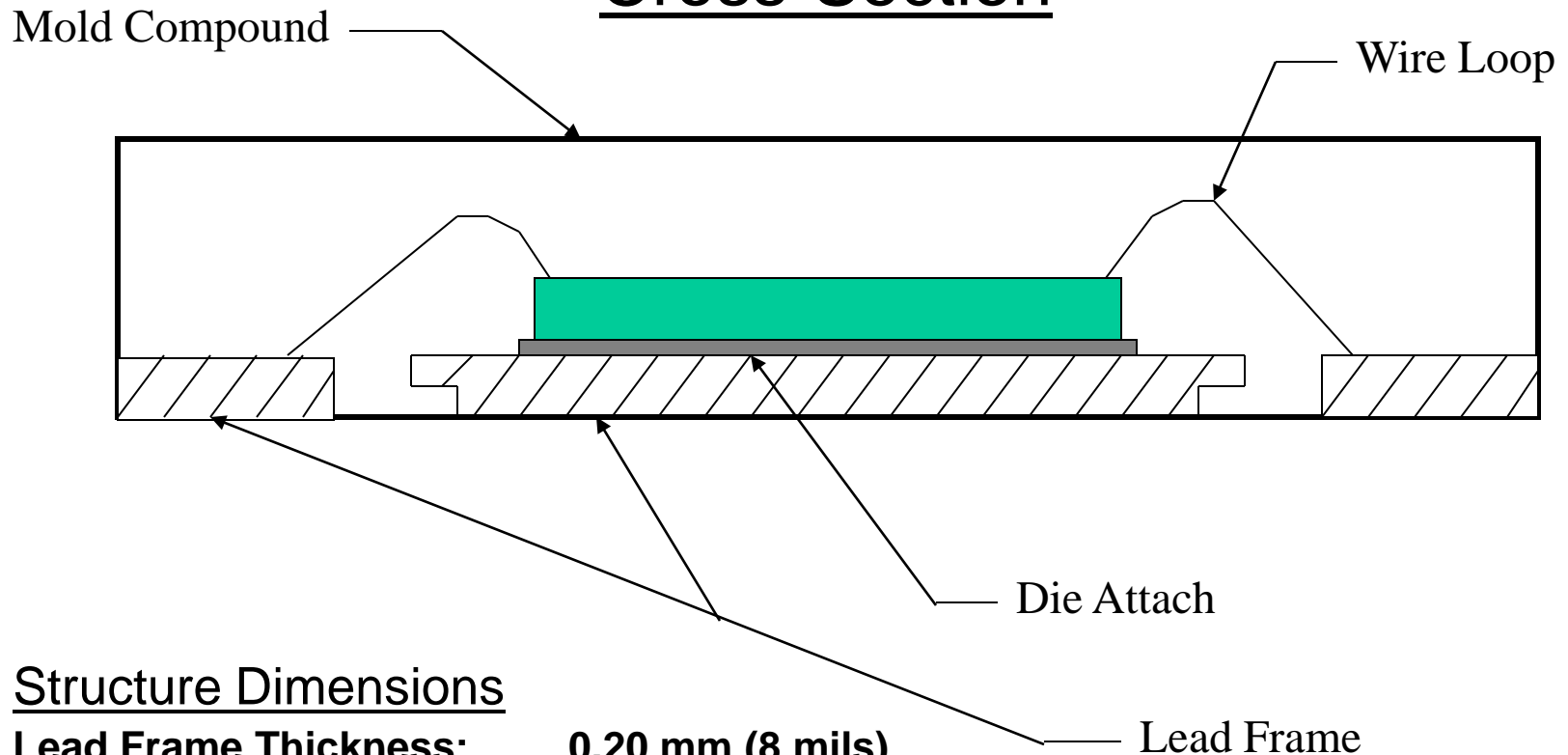
- **Molding Process : Auto Molding**

- **Warp:** Under 3 mils
- **Wire Sweep :** 4%




QFN Structure

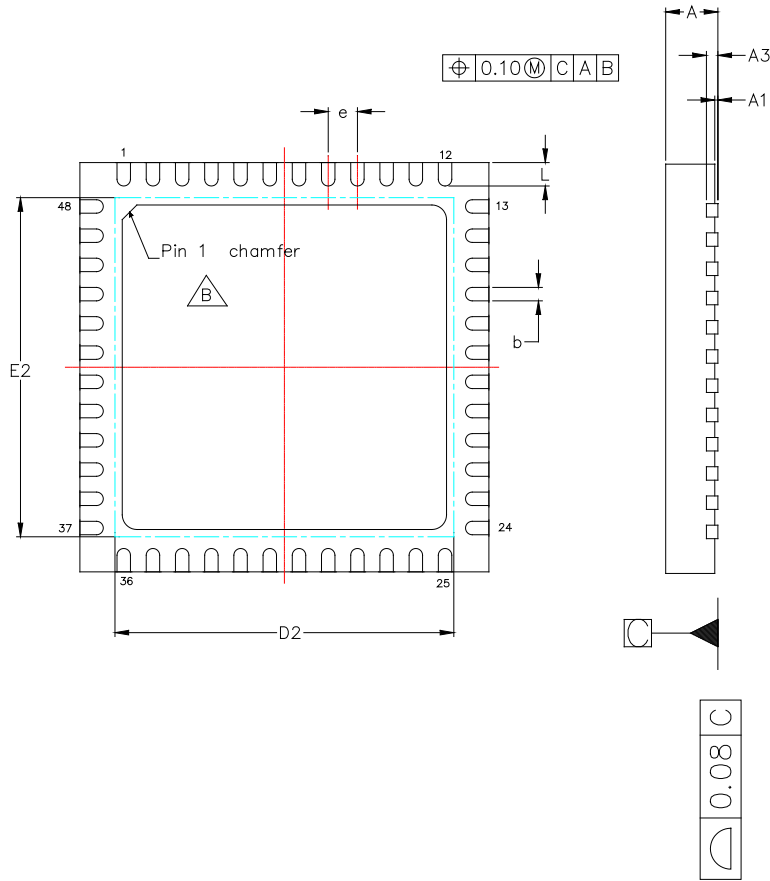
Cross-Section



Structure Dimensions

Lead Frame Thickness:	0.20 mm (8 mils)	
Die Thickness:	0.20 - 0.25mm (8 - 10mils)	
Wire Loop Height:	0.15 - 0.20mm (6 - 8 mils)	
Molded Height:	0.6 mm (23.6 mils)	
Package Height:	0.84 mm Max (33 mils)	

QFN package dimensions

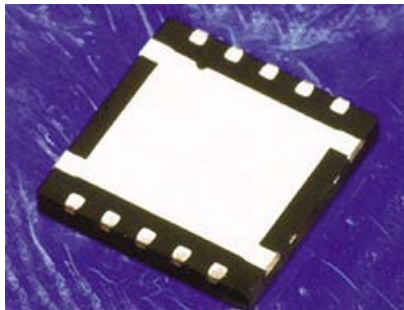
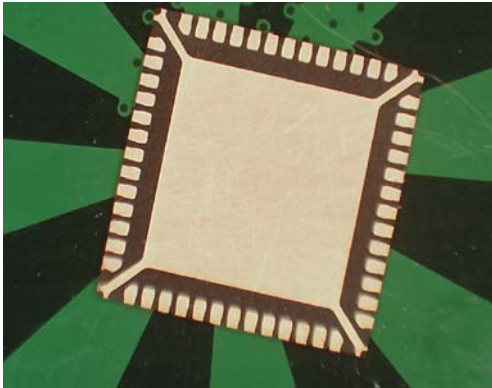


SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM	MAX.	MIN.	NOM	MAX.
A	0.80	0.85	0.95	0.031	0.033	0.037
A1	0.00	0.02	0.05	0.000	0.0008	0.002
A2	0.55	0.60	0.65	0.022	0.024	0.026
A3	0.25 REF.			0.010 REF.		
D	6.85	7.00	7.15	0.270	0.275	0.280
E	6.85	7.00	7.15	0.270	0.275	0.280
JEDEC	M0-220					

Lead Free QFN Packages

I2a can tool up any package not listed here

QFN
Package



DFN
Package

PKG Size (mm)	PAD	LEAD CT.	LD PITCH
3X3	1.6x1.6	8	0.65mm
3X3	1.6x2.0	10	0.65mm
3X3	1.8x1.8	16	0.5mm
3X3	1.9x1.9	16	0.5mm
4X4	2.1x3.7	10	0.85mm
4X4	2.1x2.1	12	0.85mm
4X4	2.3x2.3	16	0.65mm
4X4	2.5x2.5	20	0.5mm
4X4	2.9x2.9	24	0.5mm
4X4	2.6x2.6	28	0.5mm
5X5	3.9x3.9	20	0.85mm
5X5	3.8x3.8	28	0.5mm
5X5	3.8x3.8	32	0.5mm
5X5	3.9x3.9	48	0.5mm
6X6	4.2x4.2	36	0.5mm
6X6	4.3x4.3	40	0.5mm
7X7	5.5x5.5	44	0.5mm
7X7	5.8x5.8	48	0.5mm
8X8	5.7x5.7	52	0.5mm
8X8	6.8x6.8	52	0.5mm
8X8	6.0x6.0	56	0.5mm
10X10	7.1x7.1	64	0.5mm
10x10	7.4x7.4	72	0.5mm
12X12	9.4x9.4	80	0.5mm

Note: Lead Counts and Package Size Based on
Tooled Packages. Other Pin Counts and Packages
Can be Tooled to Meet Customer Requirement.

QFN Standard Materials List

Bill of Materials:

- ☐ Die Attach: MT – electrically conductive
84-3J – electrically non conductive or equiv.
- ☐ Gold Wire: 0.7, 1.0. 1.1 and 1.2 mils – 99.99 % pure gold
- ☐ Mold Compound: i2a- 9320 THF – or equivalent
- ☐ Lead Frame: Copper C194 or Eftec 64T, Ni/Pd finish
- ☐ Package Mark
Laser Mark – ink mark
- ☐ Sipping
Aluminum canisters (standard)
 - ☐ **Trays (non standard)– contact i2a sales**
 - ☐ **tape and reel (non standard) - contact i2a sales**



QFN Design Guidelines

Required Customer Input Data:

1. Package Size
2. Lead Pitch and Pin Count
3. Project & Device Name
4. Die Size
5. Number of Dies
6. Required Down Bonds
7. (Die) Bond Pad Pitch
8. ASCII Format of die Coordinates
9. Metal Bond Pad Dimensions
10. Bond Pad Opening Dimensions
11. Die Orientation
12. Special Materials, Interconnections or other Requirements
13. Thermal Requirements

QFN Design Guidelines

Design Guide Lines

- | | |
|------------------------------------|---|
| 1. Wafer Thickness: | 0.20mm – 0.25mm |
| 2. Wafer Saw Street Width (min): | 76.2 μ m |
| 3. Minimum ink dot diameter: | 381 μ m |
| 4. Bond Pad suggestions: | |
| - Bond Pad Pitch (in-line): | 60 μ m |
| - Bond Pad Opening Size (in-line): | 55 μ m |
| - Bond Pad Pitch (stagger): | 41 μ m |
| - Bond Pad Opening Size (stagger): | 70 μ m |
| 5. Gold Wire Diameter/Length: | 20/180-200 μ m |
| 6. Gold Wire Diameter/Length: | 30/250 μ m |
| 7. Maximum Die Size: | DAP Size – 0.76mm no ground bond; - 1.27mm with ground bond |

QFN DESIGN GUIDELINE

1.0 Pad Size (P) :

$$P = \text{Pkg Size} - (\text{LL} + 0.4)$$

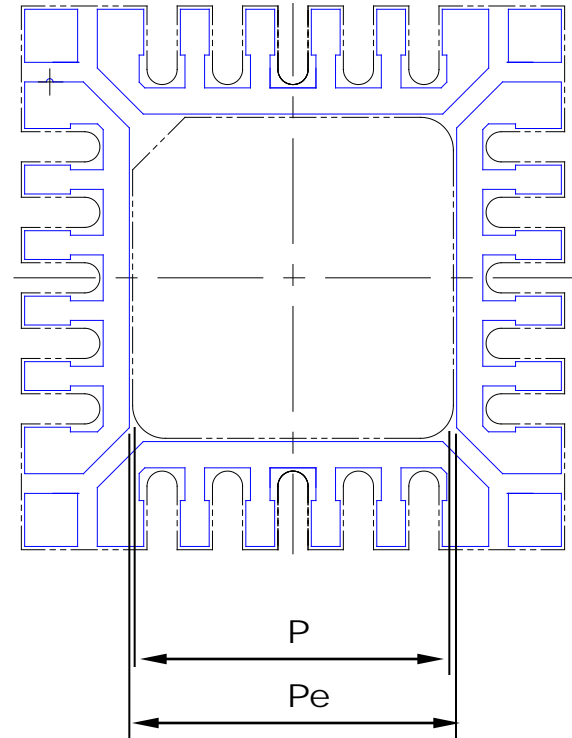
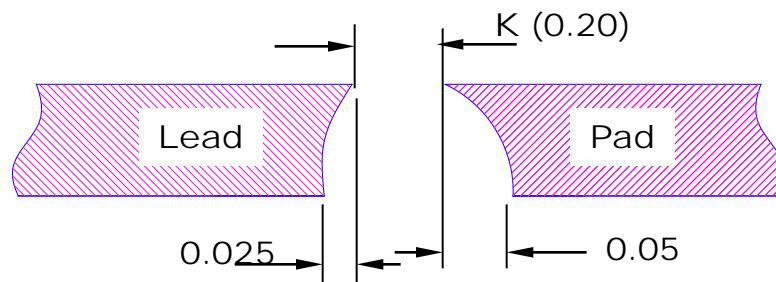
2.0 Exposed Pad (Pe) (After mold) :

$$P_e = P - 0.10$$

3.0 Etching Factor (Ef) (Top – Btm of LF) :

$$E_f (\text{Lead}) = 12.5\%$$

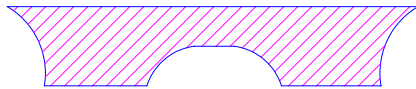
$$E_f (\text{Pad}) = 25.0\%$$



4.0 Lead is "T" to promote wider wire bond target and interlock

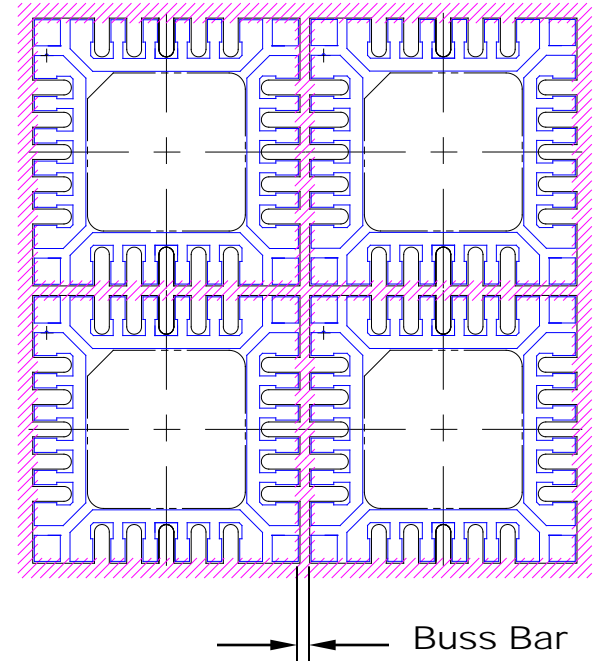
QFN DESIGN GUIDELINE

5.0 Half etch on Buss bar for ease of singulation and minimal burr



6.0 Minimum metal – metal spacing @
corner leads = 150 μm
> Corner lead chamfer may exist on
0.50 μm and 0.40 μm ILP

7.0 Packages from 10x10mm and above
will require pad slots for mold
compound locking.

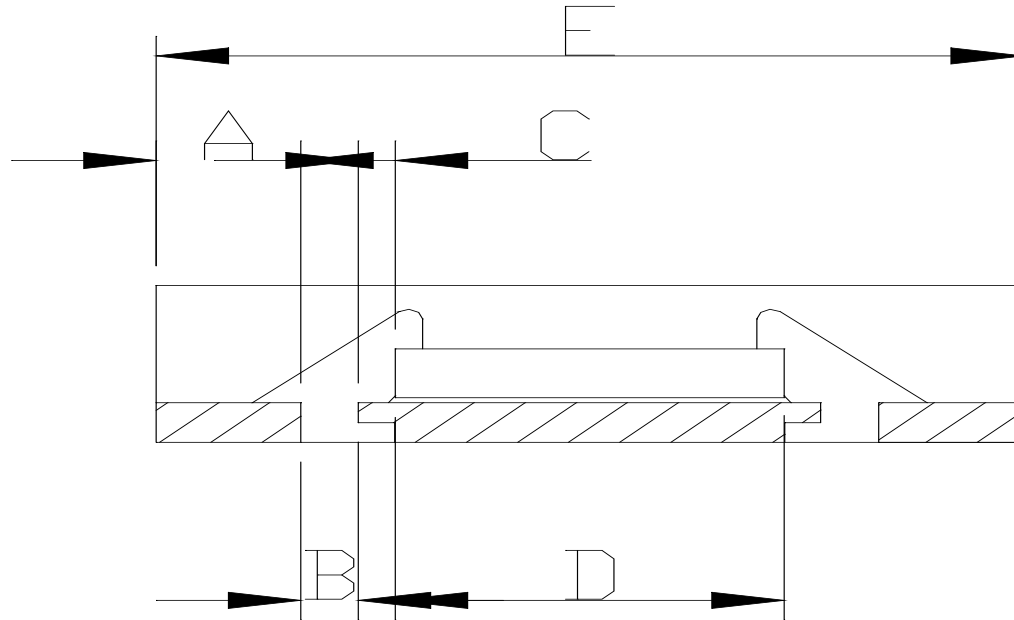


WIREBOND

- WITHOUT GROUND BOND :
MAXIMUM DIE SIZE : PAD SIZE – 0.50mm
- WITH GROUND BOND :
MAXIMUM DIE SIZE : PAD SIZE – 1.0mm
- MINIMUM PROJECTED WIRE LENGHT: 0.38mm
- MAXIMUM WIRELENGHT : 3.0mm
- LOOP HEIGHT : 0.12 – 0.20mm
- DIE THICKNESS : MAX. 0.25mm

QFN die size rule

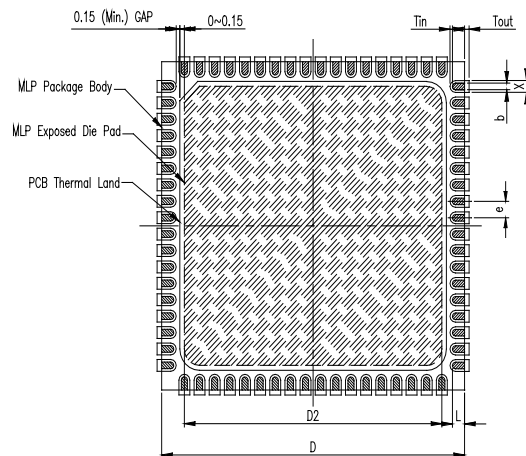
Max Die Size



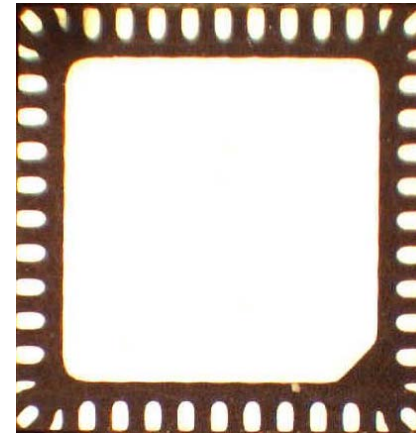
A : Lead long
B : 0.20 mm(min)
C : 0.2 mm(min)
E : Package Size

Die size (max) :
 $D = E - 2 \times A - 2 \times B - 2 \times C$
 $= E - 2A - 0.4\text{mm} - 0.4\text{mm}$
 $= E - 2A - 0.8\text{mm}$

QFN PCB Design



 MLP Package Lead
 PCB Lands



Nominal Package Lead Dimensions (mm)			PCB Land Design Dimension (mm)		
Lead Pitch (e)	Lead Width (b)	Lead Length (L)	Land Width (X)	Outward Extension (Tout)	Inward Extension (Tin)
0.80	0.33	0.55	0.42 Nom.	0.15 Min.	0.05 Min.
0.65	0.28	0.55	0.37 Nom.	0.15 Min.	0.05 Min.
0.50	0.23	0.55	0.28 Nom.	0.15 Min.	0.05 Min.
0.50	0.23	0.40	0.28 Nom.	0.15 Min.	0.05 Min.
0.40	0.20	0.55	0.25 Nom.	0.15 Min.	0.05 Min.
0.35	0.20	0.30	0.25 Nom.	0.15 Min.	0.05 Min.

QFN /DFN Thermal / Electrical Simulation Results

QFN Thermal Simulation/Modeling Test Results						
				Thermal Resistance Junction to Air (Degs C/Watt)		
Package	Size (mm)	Leads	Pad Size (mm)	Air Flow (meters/second)		
				Still	1	2
DFN	3 x 3	6	0.8 x 2.35	178	174	173
DFN	3 x 3	6	1.25 x 2.35	175	171	171
QFN	4 x 4	16	2.25 x 2.25	93	87	86
QFN	4 x 4	24	2.30 x 2.30	89	83	82
QFN	5 x 5	32	3.55 x 3.55	64	58	57
QFN	7 x 7	48	5.55 x 5.55	41	36	35

Thin Quad Flat Pack No Lead (TQFN)												
Lead Count	Package Size (mm)	Pad Size (mm)	Wire		Lead			Inductance		Capacitance		Resistance
			Diameter (μ)	Length (mm)	Length (mm)	Pitch (mm)	Width (mm)	Self (nH) Max/Min	Mutual (nH) Max/Min	Self (pF) Max/Min	Mutual (pF) Max/Min	(mΩ) Max/Min
16	4 x 4	2.4 x 2.4	25.4	1.0	0.6/0.6	0.65	0.28	0.750/0.749	0.161/0.160	0.261/0.247	0.041/0.040	42.0/41.9
32	5 x 5	3.8 x 3.8	25.4	1.0	0.4/0.4	0.50	0.23	0.752/0.751	0.162/0.161	0.221/0.212	0.036/0.035	42.1/42.0
48	7 x 7	5.8 x 5.8	25.4	2.0	0.4/0.4	0.50	0.23	1.506/1.502	0.324/0.322	0.446/0.420	0.072/0.064	84.2/84.0
72	10 x 10	2.6 x 3.2	25.4	2.5	0.4/0.4	0.50	0.25/0.20	1.883/1.878	0.405/0.403	0.558/0.525	0.90/0.080	105.3/105
Flip Chip Quad Flat Pack No Lead (FCQFN)												
Lead Count	Package Size (mm)	Pad Size (mm)	Wire		Lead			Inductance		Capacitance		Resistance
			Diameter (μ)	Length (mm)	Length (mm)	Pitch (mm)	Width (mm)	Self (nH) Max/Min	Mutual (nH) Max/Min	Self (pF) Max/Min	Mutual (pF) Max/Min	(mΩ) Max/Min
20	5 x 5	2.2 x 2.2	25.4	2.0	1.8/1.6	0.65	0.37/0.30	0.489/0.435	0.185/0.164	0.323/0.287	0.071/0.063	7.1/6.3

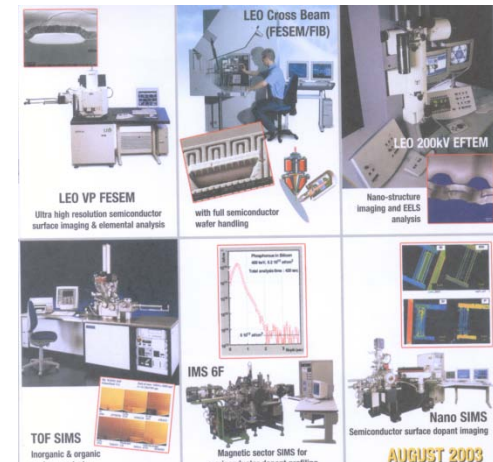
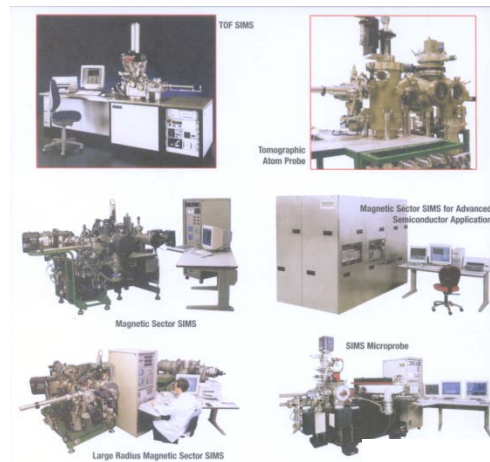
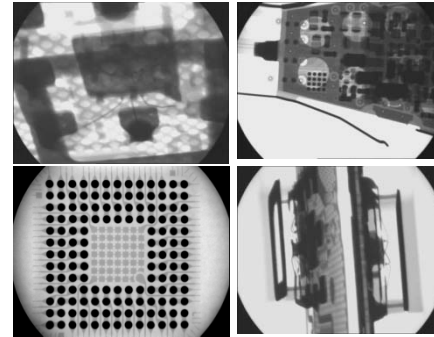
QFN/DFN Reliability Test Results

Environmental Test Results

- ❑ Moisture Sensitivity, IPC/JEDEC J-STD-020A / J-STD-033:
 - Level 1 (Reflow 240°C, 85°C/85%RH, 168 Hrs) Passed
 - Level 2A (Reflow 240°C, 30°C/60%RH, 696 Hrs) Passed
 - Level 3 (Reflow 260°C, 30°C/60%RH, 192 Hrs) Passed
- ❑ Reliability
 - High Temp Storage, +150°C, 1000 Hrs Passed
 - Temp Cycle, -65°C to +150°C, 1000 Cycles Passed
 - Thermal Shock, -65°C to +150°C, 500 Cycles Passed
 - Autoclave, +121°C, 2 atm, 168 Hrs Passed
 - Temp/Humidity, +85°C/85% RH, 1000 Hrs Passed
- ❑ Board Level Reliability
 - Temp Cycle - 40°C to +100°C, 1200 Cycles Passed

FAILURE ANALYSIS CAPABILITY

- **C-SAM**- Mould to die delamination, mould voids,
- **TMA/DSC/TGA**-Plastic characterization
- **X-ray**-Wire sweep, wire broken, solder voids, shorts and solder ball, package integrity
- **XRF**-Plating thickness and composition of pcb
- **Cross section**- Material preparation for magnification and identification
- **TOF-SIMS/AES**-Advance failure analysis tool



RELIABILITY CAPABILITY

- Air to air thermal shock (-70~220deg C)
- Temperature humidity (85 deg C/85% RH)
- Highly accelerate temperature and humidity stressed (121degC, 100% RH, 2ATM)
- Package dimensional check (lead pitch, width length, package dimensions, ball diameter,
 - pitch, Coplanarity using laser systems
- Burn-in oven
- Temperature cycling
- Hardness testing/vibration testing



- Temperature
- Cycling-Test



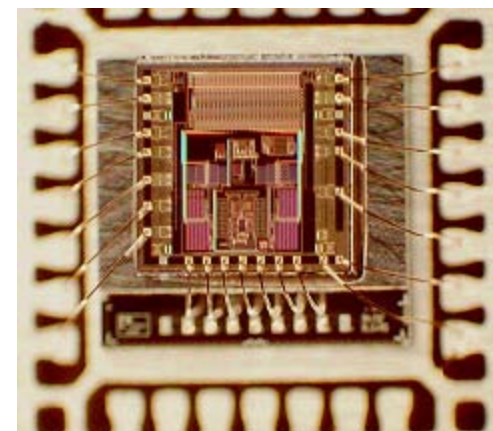
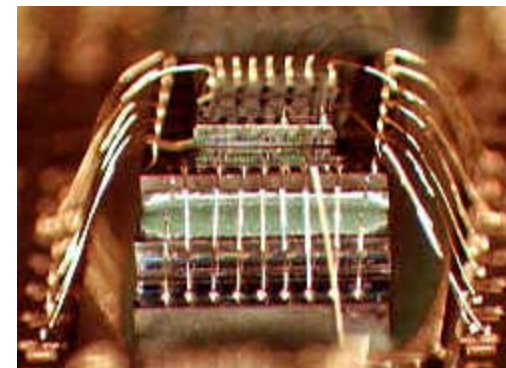
Humidity Test Chamber



Thermal Shock

QFN / DFN Progress

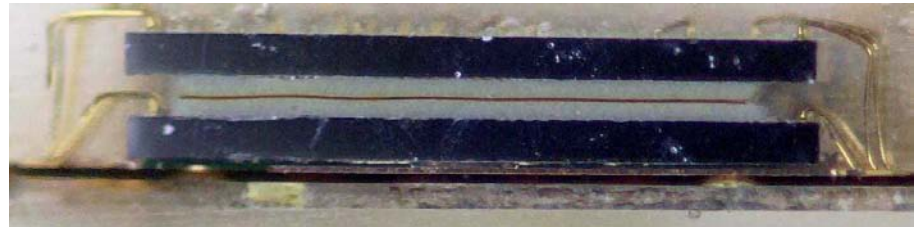
- 2005 - QFN qualified for production
 - 7x7-48 pin qualified - MSL 1 + Lead Free + Green
- 2007 - QFN technology
 - Introduced Stack die QFN - medical device
 - Started development of Flip Chip QFN
 - 8 package sizes added (24 variations)
- 2008- Flip chip on QFN Leadframe
 - 2 designs, customer approvals pending
 - Eutectic solder bumps on die
 - SIP in QFN - add SMT passive components
 - Higher pin count packages - dual row contacts
 - Add more package sizes and lead counts
- 2010- Thin QFN
 - Less than 1.0 mm thick package
 - Hybrid stacking
 - 3 die stack



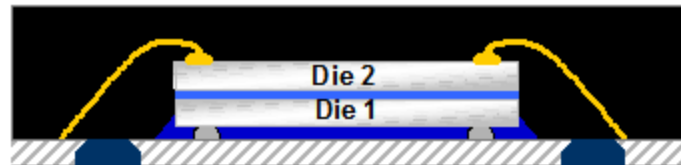
QFN/DFN

- Thin Stacked Die:

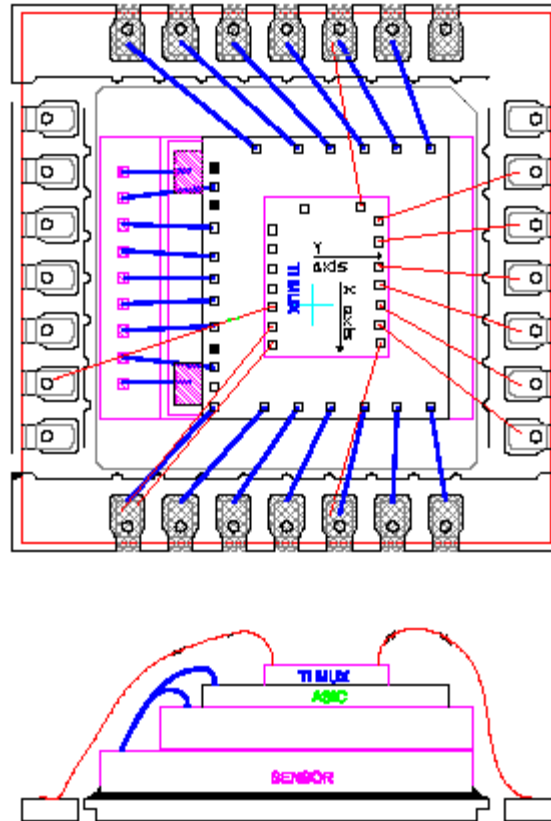
- 2 die stack



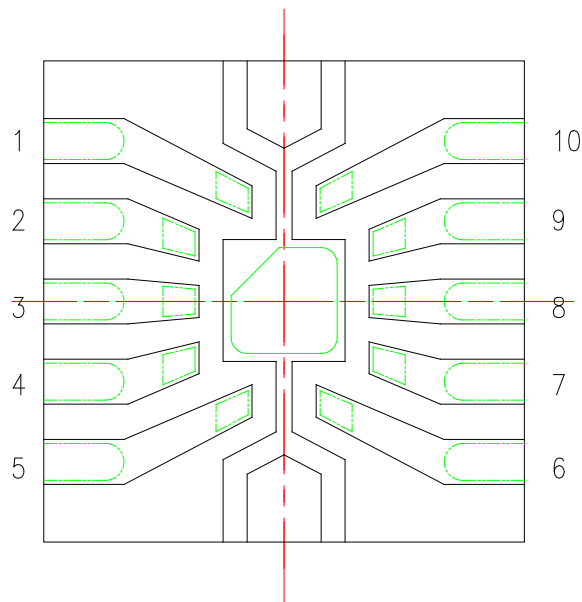
- Hybrid Flip Chip and Wire Bond



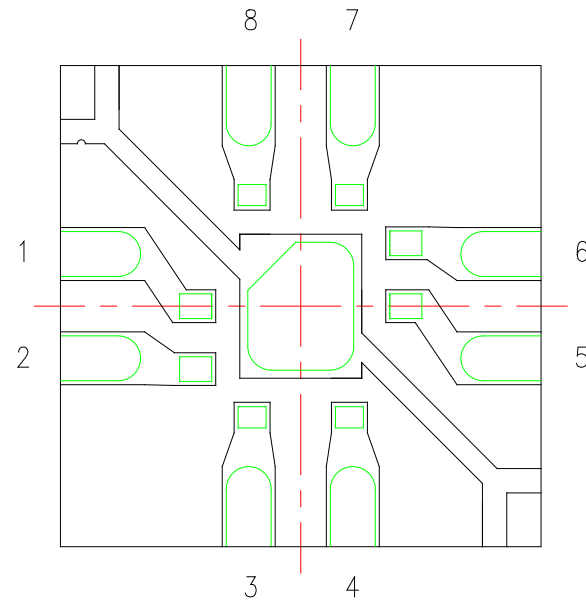
3 die stacked QFN



FLIP CHIP QFN L/F DESIGN



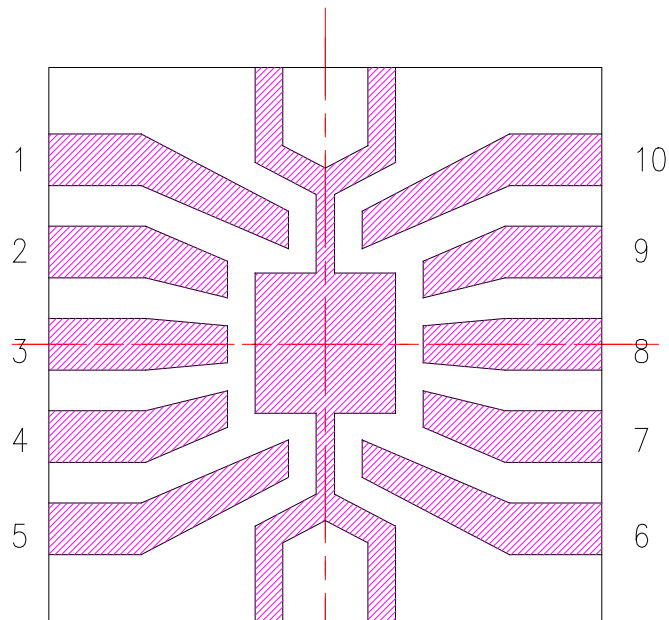
10L F/C QFN



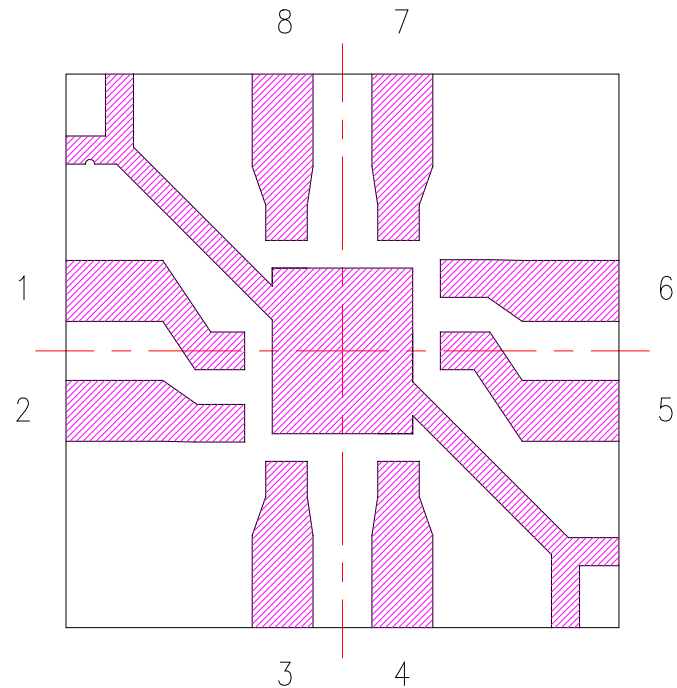
8L F/C QFN

Leadframe Design

FLIP CHIP QFN L/F DESIGN DIE SIDE



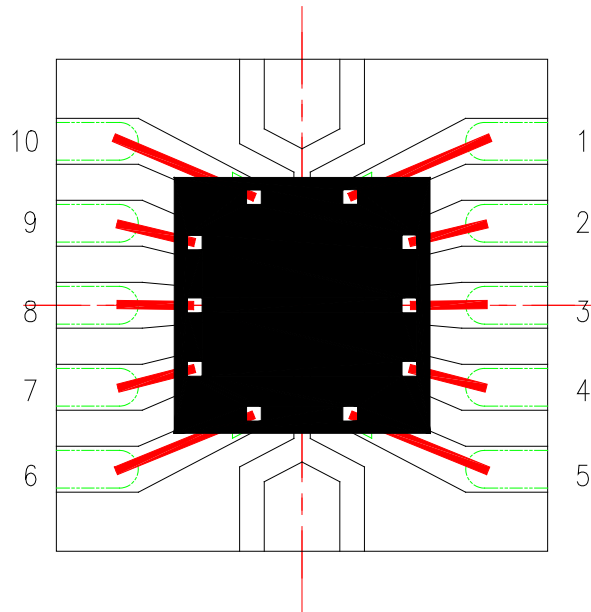
10L F/C QFN



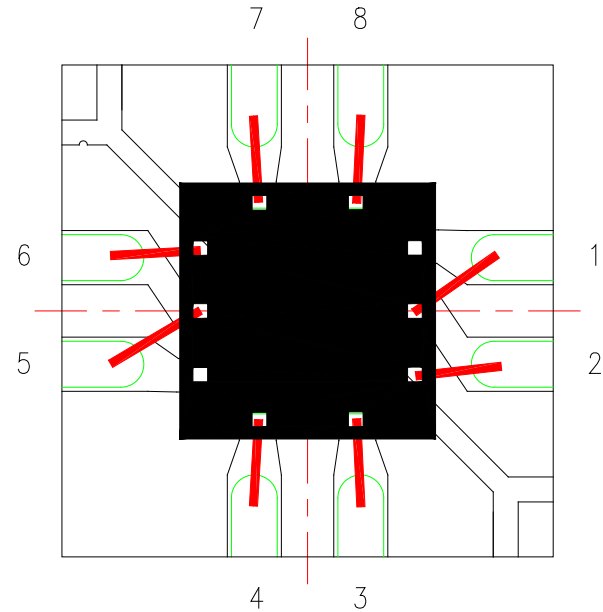
8L F/C QFN

Top side

FLIP CHIP QFN L/F DESIGN WIRE BOND



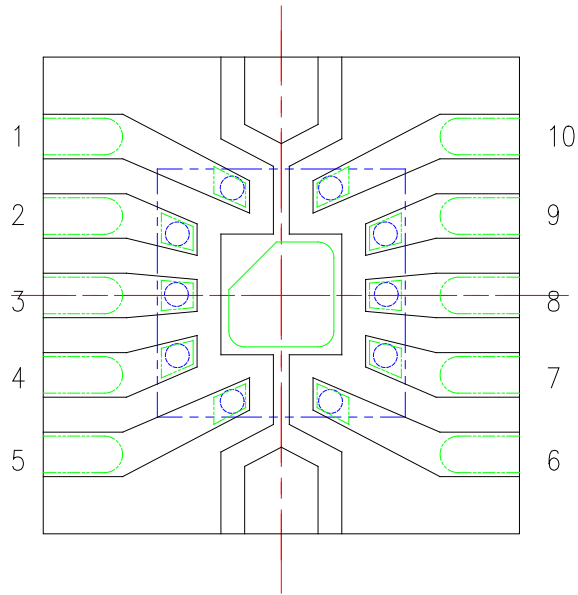
10L W/B QFN



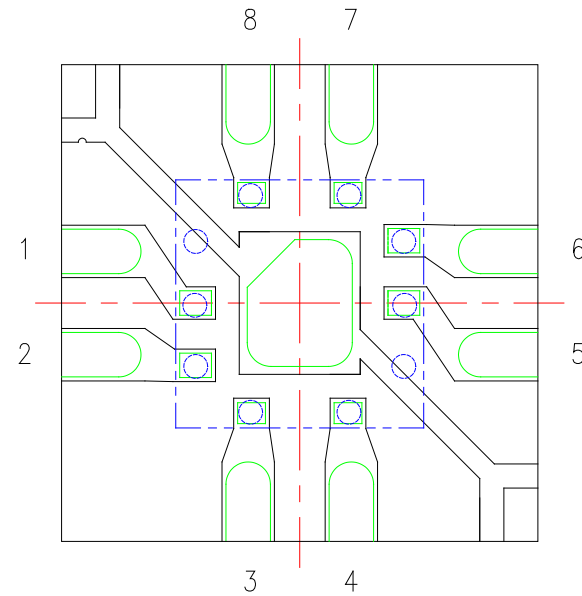
8L W/B QFN

Wire Bond Process

FLIP CHIP QFN L/F DESIGN- FLIP CHIP



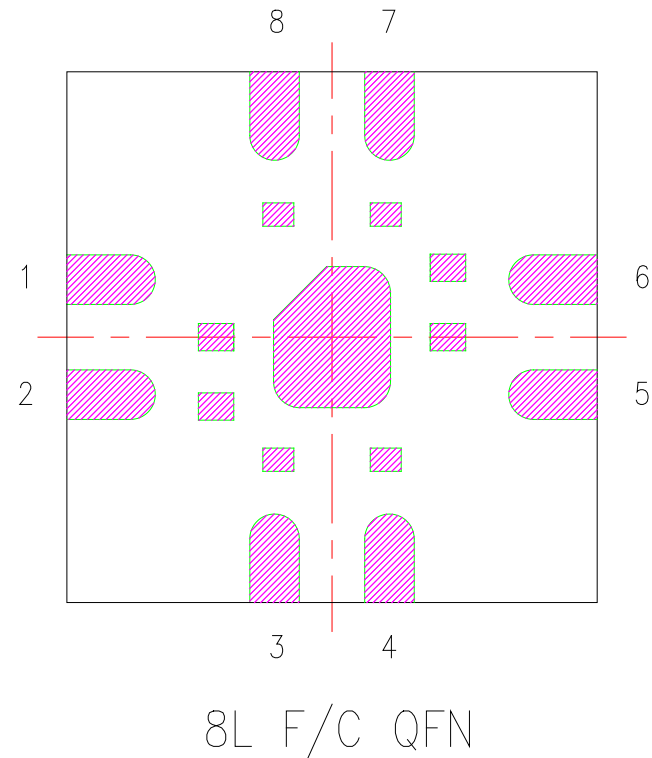
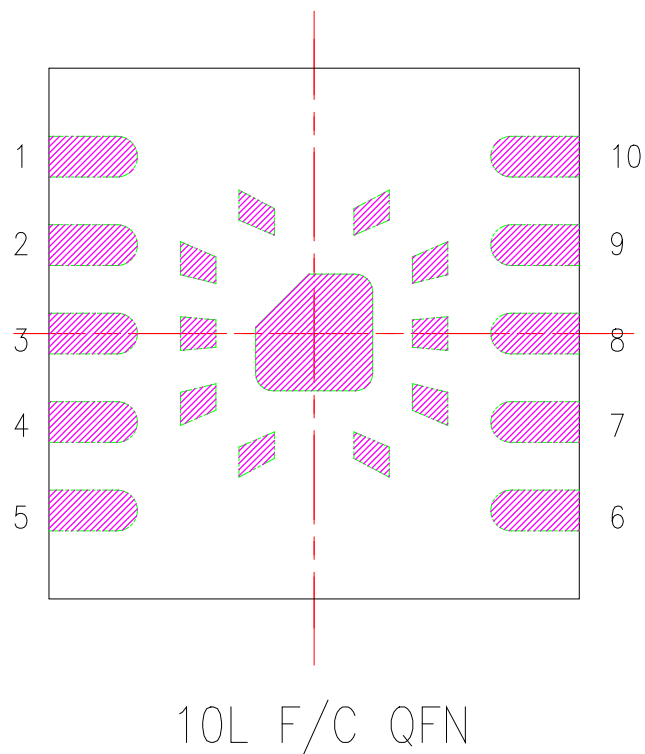
10L F/C QFN



8L F/C QFN

Flip Chip Process

FLIP CHIP QFN L/F DESIGN-MOLDED BOTTOM VIEW



Bottom side